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The Dependence Structure and Co-movement toward between Thai's Currency and Malaysian's Currency: Markov Switching Model in Dynamic Copula Approach (MSDC).

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Abstract

The international finance modelling of AEC's currencies have to be investigated more on copula approach that tests as a standard tool in financial modelling. Probabilistic capability and exposure density function are looking how to obtain empirical data for the econometric modelling of time series for financial problems. A unique question for opportunity to study this issue in the financial field is how accurate are the predictions of Markov Switching Model in Dynamic Copula approach (MSDC) algorithm. Dependent structure and co-movement between which cover available daily data during the period 2006-2013 of currencies both Thai Baht (THB) and Malaysian Ringgit (MYR) were investigated. The model selection based on AIC and BIC confirmed that the Elliptical copula fitted for those currencies appreciated value to against the US dollar. The model selection based on AIC and BIC indicated that the Elliptical copula fitted for those currencies depreciated value to against the US dollar. The overall benefit is to give the applied researchers knowledge and information which researchers can understand and apply to obtain confirmation a new reliable knowledge of MSDC and protect the wealth of money market and safety every working day.

Keywords: ***Markov Switching Model; Dynamic Copula; Exchange Rate; Thailand; Malaysia;***

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1. Introduction

Asian Economics Community (AEC) in **2015** aims to collaborate acting as a single regional economic market or a single cooperated market and production base, (Charting Progress towards regional Economic Integration, 2009). According to AEC database in 2011, the GDP of Thailand was a second rank of AEC members and the GDP of Malaysia was a third rank of AEC members in the same period. Consequently, the international finance modeling of AEC's currencies have to be investigated more. The main question is how accurate are the predictions of Markov Switching Model in Dynamic Copula approach (MSDC) algorithm. Probabilistic capability and exposure density function are looking how to obtain empirical data for the problem econometric modeling of time series. The overall benefit is to give the applied researchers knowledge and information which researchers can understand and apply to obtain confirmation a new reliable knowledge of MSDC and protect the wealth of money market and safety every working day.

2. Research Objective

The progress of specific objective is to estimate a systematic approach in dynamic copula and co-movement between currencies both Thai Baht (THB) and Malaysian Ringgit (MYR) to be tested against the case of appreciated values and depreciated values.

3. Scope of this research

Based on reference literatures the study conducted to investigate the dependence structure and co-movement toward between Baht (THB) and Malaysian Ringgit (MYR) against the US dollar based on Markov Switching Model in Dynamic Copula approach. Daily Exchange rate returns of both Thai Baht (THB) and Malaysian Ringgit (MYR) against the US dollar were collected during period of 2006-2013. The model selection based on AIC and BIC confirmed that the Elliptical copula fitted for those currencies appreciated value to against the US dollar.

4. The research framework and methodology

The copula approach is becoming the standard tool in financial modeling (Vogiatzoglou, 2010). Mohd and Zaidi (2006) found that the currencies movement among of them (Malaysia, Singapore, and Thailand). Patton (2006) found the dynamics dependence between the Deustche mark and the Yen based on copula approach. Benediktsdóttir and Scotti(2009) found the dependent structure and co-movement between currencies such as Australian dollar, Canadian dollar, Swiss franc, euro, British pound, and Japanese yen for during period of 1990-2007 and Chukiat (2011) found out the relationship between the exchange rate of Thailand and that of Malaysia is not strong for during period of 2008-2011.

4.1 The copula concept

The copula idea was first presented by Sklar's theorem (Sklar, 1959) and this idea can be explained by equations (1A).

$$H(x_1,x_2, \ldots..,x_n) = C(F_1(x_1), F_2(x_2),\ldots.., F_n(x_n)) \text{ ---- (1A)}$$

H : n-dimensional distribution with marginal F_i , i=1,2,..,n.
C : n-copula for all $x_1,x_2,\ldots., x_n$

Sklar's Theorem with every d-dimension can be explained by equation (2A) and this equation has already shown below that:-

$$H(x) = C\,(F_1(x_1), F_2(x_2), F_3(x_3), \ldots, F_d(x_d)) \quad \text{-------- (2A)}$$

H(.,.) : D-dimensional with continuous marginal distributions of F
C(.,.) : Copula for all $x_1, \ldots, x_d$ in R

4.2 Dependence Measures and Copulas

Embrechts, Lindskog, and McNeil (2003), pointed out that that the Pearson linear correlation fits only the first two properties.

1. $\delta(X,Y) = \delta(Y,X)$.
2. $-1 \leq \delta(X,Y) \leq 1$.
3. $\delta(X,Y) = 1$ if X and Y are comonotonic; as well as $\delta(X,Y) = -1$ if X and Y are comonotonic.
4. If T is exactly monotonic, then $\delta(T(X),Y) = \{\ \delta(X,Y)$, T = increasing or $-\delta(X,Y)$, T = decreasing

Nevertheless, based on the copulas idea should fit for all properties between X and Y which are random variables.

4.3 Markov Switching Model in Dynamic Copula Approach (MSDC).

However, the Markov Switching Model in Dynamic Copula approach (MSDC) was employed to estimate the marginal model with Gaussian of Thai's currency and Malaysia' currency for during period of 2006-2013. The MSDC model can be expanded from MSC by equation (4A) - (6A). The MSDC was employed to estimate the marginal model is called that MS (1)-AR(1)-GJR(1,1) for state one: currencies both Thai Baht (THB) and Malaysian Ringgit (MYR) appreciation against the US dollar and MS(2)-AR(1)-GJR(1,1) for state two: currencies both Thai Baht (THB) and Malaysian Ringgit (MYR) depreciation against the US dollar.

$$r_{i,t} = c_0 + c_1 r_{i,t-1} + e_{i,t} \qquad (4A)$$

$$e_{i,t} = h_{i,t}\varepsilon_{i,t}, \quad \varepsilon_{i,t} \approx Gaussian \qquad (5A)$$

$$h_{i,t} = \omega_{i,t} + \alpha e_{i,t-1}^2 + \beta h_{i,t-1} + \gamma e_{i,t-1}^2 1(e_{i,t-1} < 0) \qquad (6A)$$

The copula families were employed to estimate the pair of currency between Thai's currency and Malaysia's currency. The both static t copula (tDCC) and the time varying t copula (tDCC) belong to Elliptical copula. Furthermore, the Clayton copula (tvC), the static SJC copula, and the time varying SJC copula (tvSJC) belong to Archimedean copula.

5. Data description.

An estimation result of the experiment can significantly develop the prediction accuracy of Markov Switching Model in Dynamic Copula approach (MSDC) algorithm. The research progress is a systematic approach to obtain confirmation a new reliable knowledge of MSDC. Probabilistic capability and exposure density function are found how to verify hypotheses, how to obtain empirical data for the problem econometric modeling of time series. Figure (1a) presents daily exchange rate returns of both Thai Baht (THB) and Malaysian Ringgit (MYR) in percentage during the period of 2006 to 2013 Moreover, Table (1a) shows descriptive statistics of both currencies.

Table (1a) Statistics deceptive of daily exchange rate returns of Thai Baht (THB) and Malaysian Ringgit (MYR) against the US dollar: 2006-2013.

	THAI_G	MALAY_G
Mean	-0.015147	-0.009079
Median	0.000000	0.000000
Maximum	11.70813	4.739132
Minimum	-11.07482	-2.141981
Std. Dev.	0.628160	0.413484
Skewness	1.074519	0.699577
Kurtosis	130.9423	14.24100
Jarque-Bera	1279889.	10030.18
Probability	0.000000	0.000000
Sum	-28.41552	-17.03229
Sum Sq. Dev.	739.8461	320.5663
Phillips-Perron test statistic	-56.37172 (0.0000)	-45.67926 (0.0000)
Observations	1876	1876

From: computed

6. Empirical results of research

6.1. The dynamic copula and co-movement between Currencies: Thai Baht (THB) and Malaysian Ringgit (MYR) appreciation against the US dollar.

The LM test and the Kolmogorov-Smirnov test were employed to test the marginal distributions of MS(1)-AR(1)-GJR (1,1) marginal model for the performance of these currency (see the result of testing in appendix A, (Sigríður Benediktsdóttir and Chiara Scotti,2009)). The results of estimation based on dynamic copula and co-movement between Currencies both Thai Baht (THB) and Malaysian Ringgit (MYR) were presented in table (1b). The model selection based on AIC and BIC confirmed that the Elliptical copula fitted for those currencies appreciated value to against the US dollar. But the Archimedean copula did not fit for those currencies appreciated value to against the US dollar in the same period (see more detail in appendix B).

6.2. The dynamic copula and co-movement between Currencies: Thai Baht (THB) and Malaysian Ringgit (MYR) depreciation against the US dollar.

The LM test and the Kolmogorov-Smirnov test were employed to test the marginal distributions of MS(2)-AR(1)-GJR (1,1) marginal model for the performance of these currency (see the result of testing in appendix A, (Sigríður Benediktsdóttir and Chiara Scotti,2009)). The results of estimation based on dynamic copula and co-movement between Currencies both Thai Baht (THB) and Malaysian Ringgit (MYR) were presented in table (1c). The model selection based on AIC and BIC indicated that the Elliptical copula fitted for those currencies depreciated value to against the US dollar. But the Archimedean copula did not fit for those currencies depreciated value to against the US dollar in the same period (see more detail in appendix B). The Elliptical copula does not have a closed form expression as well as this copula was restricted to have radial symmetry (Daniel Berg, 2006). And Archimedean copula has a closed form expression. Moreover, the copula can be captured the higher dimensional extensions of distribution (Daniel Berg, 2006).

7. Conclusions

The purpose of this study was to estimate the dependent structure and co-movement between which cover available daily data during the period 2006-2013 of currencies both Thai Baht (THB) and Malaysian Ringgit (MYR). Exchange rate signals in money market acting as a key mechanism explain probability that an individual trader uses to indicate the price information on currency movements. The applicable method of solution in the computations indicated that Markov Switching Model in Dynamic Copula approach (MSDC) algorithm presents the evidence used to support the existence of identically distributed density. The first regimes represented appreciation against the US dollar. And the second regimes represented depreciation against the US dollar. In addition, both first regimes and second regimes found dependent structure and co-movement between two currencies explained by Elliptical copula. In terms of recommendation, an estimation result of the experiment can significantly develop the prediction accuracy of Markov Switching Model in Dynamic Copula approach (MSDC) algorithm. The research progress is a systematic approach in dynamic copula and co-movement between Currencies to obtain confirmation a new reliable knowledge of MSDC. Probabilistic capability and exposure density function are found how to verify hypotheses, and finally how to obtain empirical data for the problem econometric modelling of time series.

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Appendix A

Table (1c) Testing of the marginal distribution models based on LM-test and K-S Test for MS(1)-AR(1)-GJR(1,1) model

	Thailand	Malaysia
First moment LM test	0.777	0.334
Second moment LM test	0.939	0.593
Third moment LM test	0.983	0.785
Forth moment LM test	0.942	0.898
K-S test	0.365	0.264

Table (1d) Testing of the marginal distribution models based on LM-test and K-S Test for MS(2)-AR(1)-GJR(1,1) model

	Thailand	Malaysia
First moment LM test	0.774	0.890
Second moment LM test	0.938	0.986
Third moment LM test	0.978	0.997
Forth moment LM test	0.994	0.999
K-S test	0.383	0.495

LM-test: test for serial independence of the residual terms of marginal model (all of residual terms are satisfied for all of marginal models were employed to estimate the copula model).

K-S test: test for the uniform distribution of marginal models (If a p value more than 0.05 then the marginal model is well-specified).

Appendix B

Table (1b) : Present the estimated marginal parameters correspond to MS(1)-AR(1)-GJR(1,1) toward the copula-family.

MS(1)-AR(1)-GJR(1,1)	Thailand		Malaysia	
	(marginal parameters)	SE.	(marginal parameters)	SE
C_0	-0.076654***	0.006630	-0.169056***	0.008589
C_1	-0.124856***	0.031533	0.043135*	0.023011
ω	-0.001012***	0.000396	-0.001088**	0.000452
α	0.472461***	0.144907	0.260395***	0.049987
β	-0.169853	0.145129	-0.194014***	0.050034
γ	0.846815***	0.003540	0.915064***	0.006647
Log-likelihood		-252.2800		-239.0376
AIC		0.275499		0.261373
BIC		0.293215		0.279090
Static t-copula (t)			parameters	SE.
v			198.69***	0.643
AIC			-68.98	
BIC			-63.44	
Log-likelihood			35.49	
Time varying t(tDCC)			parameters	SE.
v			199.84***	9.64
α			0.0026	0.002
β			0.9869***	0.007
AIC			-72.03	
BIC			-55.42	
Log-likelihood			39.01	
Clayton Copulas (tVC)			parameters	SE.
ω			-2.01***	0.699
α			0.959**	0.673
β			0.049	0.393
AIC			-62.58	
BIC			-45.97	
Log-likelihood			34.29	
Static SJC copula			parameters	SE.
τ^U			0.024	0.005
τ^L			0.095***	0.030
AIC			-62.32	
BIC			-51.25	
Log-likelihood			33.163	
Time varying SJC copula	Upper Tail	SE.	Lower Tail	SE.
ω	-9.11*	6.78	-2.16**	0.77

α	-3.58	37.16	0.65	4.55
β	9.58	9.34	-0.03	0.36
AIC			-54.68	
BIC			-21.46	
Log-likelihood			33.34	

From: computed.
SE: Standard errors are in table.
*, **, ***: Significance at 1%,5%,10%

Table (1c) : Present the estimated marginal parameters correspond to MS(2)-AR(1)-GJR(1,1) toward the copula-family.

MS(2)-AR(1)-GJR(1,1)	**Thailand**		**Malaysia**	
	(marginal parameters)	**SE.**	**(marginal parameters)**	**SE**
C_0	0.055857***	0.004728	0.061501***	0.010301
C_1	-0.092829***	0.018854	0.057510***	0.012664
ω	-0.005679***	0.000694	0.000454	0.001550
α	0.518860***	0.019639	0.020985**	0.009829
β	1.861192***	0.570185	2.676238***	0.760588
γ	0.809176***	0.003776	0.787868***	0.028988
Log-likelihood		-231.6373		178.2664
AIC		0.253480		-0.183751
BIC		0.271196		-0.166034
Static t-copula (t)			**parameters**	**SE.**
v			198.69***	0.643
AIC			-68.98	
BIC			-63.44	
Log-likelihood			35.49	
Time varying t(tDCC)			**parameters**	**SE.**
v			119.84***	9.64
α			0.0026	0.002
β			0.9869***	0.007
AIC			-72.03	
BIC			-55.42	
Log-likelihood			39.01	
Clayton Copulas (tVC)			**parameters**	**SE.**
ω			-2.019***	0.699
α			0.959***	0.673
β			0.049	0.393
AIC			-62.58	
BIC			-45.978	
Log-likelihood			34.29	
Static SJC copula			**parameters**	**SE.**
τ^U			0.0024	0.005

τ^L			0.0955***	0.030
AIC			-62.32	
BIC			-51.25	
Log-likelihood			33.163	
Time varying SJC copula	**Upper Tail**	**SE.**	**Lower Tail**	**SE.**
ω	-9.11*	6.78	-2.16**	0.77
α	-3.58	37.16	0.65	4.55
β	9.58	9.34	-0.03	0.36
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BIC			-21.46	
Log-likelihood			33.34	

From: computed.
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